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AN OPINION TO CONSTRUCT FRAMEWORK OF MEASUREMENT SCIENCE ON EDUCATION KNOWLEDGE SYSTEM

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Abstract – As Knowledge system, many kind "Sciences" had discussed and authorized. For example, "Earth Science", "Human Science", "Medical Science", "Sports Science", "Welfare Science", ------ are typical Sciences. And these almost Sciences are discussed relate with Man, Earth and Space. "Measurement Science" is discussed same situation and sometimes authorized by mathematical "Set Theory" [1],[2],[3],[4]. But do not never forget that an act of measurement supports every time the judgement of an action of a man.

Author had reported some papers at relation with "Education and Measurement Science", and pointed the significance of "Framework of Measurement Science". Then "a Set *Need*" was proposed for the understand of "Measurement Science" [5],[6],[7],[8],[9],[10],[11],[12].

Introduce of this ***Need*** operates effectively to education of all fields and ranks to rise up scientific and technical sense of people live in society. This education is called as **"Liberal Education".**

This paper shows a view to construct "Framework of Measurement Science" applicable to Liberal Education".

Keywords: Liberal Education, ***Need***, stochastic process

1. HUMAN ACTION AND AN ACTION OF MEASUREMENT (First View point of Frame work of Measurement Science)

"An action of a man constructs society by together the action and society is going to develop". This is conventional vision. Here important thing is that an action of a man is taken by a judgement of measurement. An act of measurement is like indicate next an act to do judge right, quick and it urges an action of a man.

Society ⇒ An action of a man ⇔ Judgement
(Measurement – many kind) (right, quick)

In here many kind of Measurement (Principle, Method, System, -----) have being developed. On Liberal Education, in the first, the relation with an action of a man (human action) and an act of measurement should be explained by plain examples. In measurement system, many kind of sensors are made and distributed so that sensor itself, sensor system, measurement system, ------ etc. are easily explained. The role of measurement is, by supporting an action of a man contributing to society. Therefore introduce a concept "Need of an action of a man : ***N***", and a set "An act to measure opposite ***N*** : ***M***". Then "Relation with ***N*** and ***M***" is given as a Mapping

$$\boldsymbol{f}: \boldsymbol{N} \rightarrow \boldsymbol{M}. \quad (1)$$

On "General Measurement System", ***M*** is indicated as

$$\boldsymbol{M}pq\ (P=1,2,3,\text{---},\ q=1,2,3,\text{---}) \leftarrow (\boldsymbol{M} \mid \boldsymbol{N}) \quad (2)$$

by condition ***N***. p shows character of such system to construct measurement system, and q shows also the character of the system (sub-system, sub-sub system) to construct the sub system. On the education it is very important to how select p and q by ***N***. It is problem of "Causality for ***Mpq***" and "Practical measurement system".

Causality needs for ***Mpq***, and it is given ***Cause*** or Input ***I*** and ***Effect*** or Output ***R***. At practical measurement system, the relation is written as

$$\boldsymbol{I} \bullet [\ \boldsymbol{M}pq\ ] \rightarrow \boldsymbol{R} \quad \text{or} \quad \boldsymbol{I} \times 【\ \boldsymbol{M}pq\ 】 \Rightarrow \boldsymbol{R} \quad (3)$$

• : a product
×：a cartesian product
［***Mpq*** ］: Technical definition function
【 ***Mpq*** 】: Scientific definition function.

Here, ***I*** is clear comparatively by ***N***, but for ***Mpq*** there are many kind selection and it should be decided by the social effect of ***R***.

2. SENSING AND ITS BASIS (Second View point of Frame work of Measurement Science)

Based on Need ***N***, various sensors have been developing by fundamental principle of sensing. The principles are given as three Modes. First Mode is direct use of physical laws, Second Mode is use of reaction to given stimulus and Third Mode is comparison with prepared equivalent quantity.

Sensing is originally practiced by the five senses (sight, hearing, smell, tast and touch) of a man. But now the use of electronic sensor becomes naturally. In education the difference should be explained. It is the difference with feeling sensing and engineering sensing, and the problem of Empirical relation. The Empirical relation is an important fundamental thought of Theoretical Structure of Measurement with Representation Theorem and Uniqueness Condition.

Next, important education thing is that the result of sensing appears by the form of signal $\boldsymbol{s}(t)$. Now, if p=1

shows sensor system, and by q, sensor mode is given, it becomes need to give the factor of practical sensor sort, for example, temperature sensor, infrared sensor, radiation sensor, ----- . Then, by indicating, the factor as $-r$, the sensor system is shown as

$$\boldsymbol{M}\, p{=}1,\, q\text{-}r \;\leftarrow (\boldsymbol{M} \mid \boldsymbol{N}), \tag{4}$$

and the Effect of Output $\boldsymbol{R}$ is shows

$$\boldsymbol{I} \bullet [\boldsymbol{M}\, p{=}1,\, q\text{-}r\,] \rightarrow \boldsymbol{R} \tag{5}$$

$$\boldsymbol{m}(\mathrm{t}) \bullet [\boldsymbol{S}\, q\text{-}r \mid N] \rightarrow \boldsymbol{s}\, r(t) \tag{6}$$

where, $\boldsymbol{m}(t)$: Change of state or situation of measurement object
$\boldsymbol{s}\, r(t)$: Signal (time series)
$\boldsymbol{S}\, q\text{-}r$: Sensor, q indicates principle (Mode)
r shows sort of sensor
generally, sensor system is set in first stage of measurement system, so p=1 is normal.

In education, these relation that is shows by formula (6) should be explained, especially the existence of condition $\boldsymbol{N}$, the transformation from change of measurement object $\boldsymbol{m}(t)$ to signal $\boldsymbol{s}(t)$ and understand of Stochastic Process of signal $\boldsymbol{s}(t)$.

An action of a man starts by knowing the change of state and situation. Here the "knowing" has important meaning on education. The "knowing" happens by Need of an action of a man so that the description of formula (6) is appreciate. Namely, the change of state or situation which is time series $\boldsymbol{m}(t)$ becomes measurement object. Then $[\boldsymbol{S} \mid \boldsymbol{N}]$ is a converter to convert from $\boldsymbol{m}(t)$ to $\boldsymbol{s}(t)$, and enough explain of this conversion is wanted. $\boldsymbol{S}$ is treated as Sensor, but it dose not forget to add the condition $\boldsymbol{N}$.

The signal s(t) is, in the almost case , a time series signal of stochastic process which is shown by next formula (7).

$$\{\mathrm{s}(t;\omega);\ -\infty<t<\infty,\ \omega \in \Omega\} \tag{7}$$

In case of continuous

$$\{\boldsymbol{s}(t)\ ;\ t=0,\pm1,\ \pm2,\ ---\ \omega \in \Omega\} \tag{7'}$$

In case of discrete

Then $\boldsymbol{s}(t)$ is given by

$$\boldsymbol{s}(t) = \{\boldsymbol{s}(t\ ;\ \omega=\omega\, i)\ ;\ -\infty<t<\infty\}. \tag{8}$$

On Liberal Education level, it is very difficult to understand the relation of formula (7) and (8), especially understand of the image, so that the effort needs[13]
.

3. SIGNAL AND INFORMATION, AND SOCIETY (Third view point of Frame work of Measurement Science)

The output of sensor is a time series signal $\boldsymbol{s}(t)$, and it is a signal that the change of event (measurement object) is converted by converter $[\boldsymbol{S} \mid \boldsymbol{N}]$. Then in this signal, the information rerate with the change of event is embedded. But the signal which is able to measure by sensor is a sample signal which was regulated by a stochastic parameter $\omega = \omega\, i$ as like shown by formula (8). In education, this fact should be taught enough, then the result is expected as progress of ability of knowledge acquisition of people. It is the understand of signal structure, that is stochastic process of signal. Here, important understand items are

- set probability density function and sample probability density function.
- stochastic process.
- various stochastic process.
  - stationary process.
  - ergodic process.
  - stationary-ergodic process.
  - none stationary process.
  - other special process.

On Liberal Education, the change or transfer of probability density function should be discussed and from the transition of its change or transfer, it is wanted to know the information of change of state and situation of event (measurement object). At practical measurement, amplitude probability density distribution of sample signal is measured, and from its time transition, embedded information is grasped.

Those process to grasp the embedded information is now almost case practiced by electronic technique, and the electronic circuit potential and power level are very small. Then generally the system of "Signal Matching and Analysis" is used. This system is indicated as $\boldsymbol{M}\, p$=2

$$\boldsymbol{M}p{=}2,\mathrm{q\text{-}r} \leftarrow (\boldsymbol{M} \mid \boldsymbol{N}) \quad . \tag{9}$$

The output shows like next similarly with in the case of $\boldsymbol{M}\, p$=1.

$$\boldsymbol{I} \bullet [\boldsymbol{M}p{=}2,q\text{-}r] \rightarrow \boldsymbol{R} \tag{10}$$

$$\boldsymbol{S}r(\mathrm{t}) \bullet [\mathrm{A}q\text{-} \mid \boldsymbol{N}] \rightarrow \boldsymbol{s}\, i\,(d). \tag{11}$$

Where $\boldsymbol{s}\, r\,(t)$; output signal of sensor
$\boldsymbol{s}\, i(d)$; embedded information
$\boldsymbol{A}\, q\text{-}r$; Signal Analyzer
q indicates principle
r shows sort of signal analyzer.
generally, in second stage of measurement system, signal analysis system is set

Here in education, it is important to explain that the purpose of the system is to searching embedded information of the relation with $\boldsymbol{N}$. In above mentioned example, time transition of amplitude probability distribution is not appear in the signal $\boldsymbol{s}\, r(\mathrm{t})$. This is a result of an analysis $\boldsymbol{s}\, i(d)$ by Signal Analyzer $\boldsymbol{A}\, q\text{-}r$, for example Probability Analyzer.

In next important education point is the relation with Information and Knowledge. Imbedded information should be used effectively for judgement of an action of a man. Here the effective information becomes Knowledge and it has important role as analysis. Namely it is idea of non worth information and worth information. The worth information will be said as information having rationality and it is Knowledge. On education, the process to know information in

signal and to take information and to get knowledge must be explained enough. Particularly embedded information becomes important on the judgement of an action of a man in society.

For example, when practice the predict of Typhoon disaster, the information which is get by normal wind and atmospheric pressure measurement is not enough. Then by doing wind strength frequency distribution and the frequency transition distribution measurement, it becomes possible to predict the size, the course, the scale, the dangerous degree and etc, of the Typhoon. This is an effect of [Aq-r | N] → $s(d)$, formula (10). And it is done by N.

4. MEASUREMENT SCIENCE AND SOCIETY (Forth view point of Frame work of measurement Science)

The knowledge as result of measurement flooding everywhere on society. Some times the results are indicated as signal and information as it is. And the people live in society are working by using the results. Then an action of a man by need N operates to society so that the base of the action of people is using the knowledge which is results of measurement..

Generally in the education at measurement, purpose of measurement, measurement object, sensor, several kind electronic circuit, measurement system, measurement information, ----- are discussed and taught. And many papers, data, books, ----- are distributed.

Proposing education here and past reported some papers dose not stand in such stand point. By standing the frame work of measurement, scientific and technical knowledge level of people at information age is raised up, and its education should be practiced early time of all education fields and ranks. This proposing education here is called as "Liberal Education". Namely, it is an education that is raised up scientific and technical knowledge of people by studying Measurement Science. The reason is, already stated, an action of a man starts by an act of measurement and a man works in society. The society consists of an act of measurement of people.

The method to get information and to get knowledge should be discussed. In practice many kind systems are developed and computerized. But description as frame work should be done same with Mp=1, Mp=2

The system of knowledge acquisition Mp=3 is

$$M\,p{=}3,\ q\text{-}r \leftarrow (M \mid N). \quad (12)$$

$$I \bullet [M\,p{=}3,\ q\text{-}r] \rightarrow R \quad (13)$$

$$si(d) \bullet [U\ q\text{-}r \mid N\ ] \Rightarrow K \quad (14)$$

Where, $si\,(d)$; Embedded Information
K ; Knowledge Analyzer
q indicates principle
r shows sort of knowledge analyzer

And, when the need N becomes zero, the role of measurement finish, that is, an action of a man dose not need. Then an act of measurement in this term is important contribution for society. If indicate it as social activity of measurement, it is possible to give by same method with Mp=1 ~Mp=3

$$M\,p{=}4.q\text{-}r \leftarrow (M \mid N \rightarrow 0\,.) \quad (15)$$

$$K \Rightarrow [SA \mid N \rightarrow 0] \Rightarrow C \quad (16)$$

Where, K ; Knowledge
SA ; Social activity of measurement;
C ; Social contribution of measurement

But here, important education point is doing effort the condition becomes N 0. This is important meaning of measurement.

5. CONCLUSION

When we look the curriculum of general school, for example, junior school, middle school and etc. in them, as a subject "Measurement Science" is not exists. In this paper by arranging the Frame Work of Measurement Science, doing the education grads up of scientific and technical sense of people is proposed. When indicate some view points of Measurement Science are cleared accommodation in education of all field and ranks, the fundamental ability of scientific and technical sense of people will be cultivated..

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[13] Same with [4].

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